Table 1
Telecommunications Input Prices
Grew at the Same Rate as U.S. Input Prices

	Change in GNP-PI	Change in U.S. TFP	Change in U.S. Input Prices	Change in Telecom Input Prices (ETI)	Change in Telecom Input Prices (NERA)
1985	3.40%	1.60%	4.99%	2.37%	8.37%
1986	2.82%	1.39%	4.21%	-2.67%	6.66%
1987	3.05%	1.19%	4.23%	8.46%	12.15%
1988	3.85%	2.42%	6.27%	-7.66%	3.37%
1989	4.40%	-0.36%	4.04%	-12.94%	2.66%
1990	4.41%	-0.89%	3.52%	13.34%	0.79%
1991	3.95%	0.89%	4.84%	13.34%	3.34%
1992	2.96%	0.89%	3.85%	NA	-1.07%
Average	3.61%	0.89%	4.50%	2.03%	4.53%
Standard Deviation			0.81%	9.54%	4.02%

Sources: GNP-PI (1987 base) is taken from the Bureau of Labor Statistics.
TFP is the BLS' Private Business Sector Multifactor Productivity Change through 1990.
1991 and 1992 are set at the 1985-1990 average. The change in U.S. input prices is the
sum of GNP-PI and U.S. TFP.

a whole along with estimates of telecommunications input price changes presented by ETI (for

California LECs) and by NERA (for Pacific Bell). The differences between U.S. input price

growth and the two measures of telecommunications input price growths are shown in Table

2. Using either ETI's or NERA's estimate of the telecommunications input price growth rate,

the appropriate statistical test does not reject the hypothesis that input price growth rates are

the same for telecommunication firms and average U.S. firms at conventional levels of

significance.[46] Thus the input price measures filed in California by both NERA and ETI support the hypothesis that national input price growth is equal to the telecommunications industry price growth. And as we have presented earlier, under these circumstances, ETI's price adjustment formula is mathematically equivalent to the Commission's price cap formula, so that no adjustment for an input price growth differentials is necessary--or warranted--to calculate a productivity offset X from an estimate of the productivity differential.[47]

In addition, Ad Hoc's own California study contradicts its claim of general agreement among studies that telephone input prices grew more slowly than GDP-PI. Ad Hoc's Equation (4), page 57, expresses the relationship among the LEC's input prices, output prices, and TFP:

$$d\ OP_T = d\ IP_T - d\ TFP_T\ .$$

Based on this relation, any one of the factors can be calculated if the other two are available. In fact, Ad Hoc calculated an output price growth of -2.5 percent and a TFP of 6.5 percent (see page 59), implying an input price growth of 4.0 percent. This rate is higher than the GDP-PI growth rate of 3.7 percent over the same period.[48] Finally, we combine Christensen's TFP studies for the 1959-1987 and 1984-1992 periods to estimate the input price growth rate

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[46]The absolute value of the t statistics would have to exceed 2.45 for the average difference between telecommunications and U.S. input price changes to be statistically significantly different from zero at the 95 percent confidence level.

[47]Even though our study compared LEC input prices directly with national input prices, it is simple arithmetic to translate the results to a GNP-PI differential--by adding U.S. TFP growth. Thus, our study produced a differential of negative 0.9, directly contradicting Ad Hoc's claim of agreement among studies that telephone input prices grew at less than GDP-PI. There was considerable confusion over whether an input price differential was equivalent to the difference between LEC input price growth and GDP-PI in the California proceeding. Thus, ETI's statement: "ALJ Reed further concluded that Pacific Bell had not provided any evidence to the contrary: 'As such, the assertion that the average difference between the two is 1.6% does not appear to be refuted in the record'" evidently represents the ALJ's understanding. However, we note that NERA's study was, in fact, on the record and does directly refute ETI's conclusion.

[48]Direct Testimony of David J. Roddy, Application 92-05-002 and 92-05-004 before the California Public Utilities Commission, April 8, 1993, Appendix 2, p. 8.

Table 2
There Is No Difference Between
Telecom and U.S. Input Price Growth

	Difference Telecom - U.S. Input Price Changes (ETI)	Difference: Telecom - U.S. Input Price Changes (NERA)
1985	-2.62%	3.37%
1986	-6.88%	2.45%
1987	4.22%	7.92%
1988	-13.93%	-2.90%
1989	-16.99%	-1.39%
1990	9.82%	-2.73%
1991	8.50%	-1.50%
Average	-2.55%	0.75%
Standard Deviation	9.84%	3.71%
t-statistic for H_0: Difference = 0	-0.64	0.49

differential for the LEC industry.[49] As shown in Figure 4, the average differential is quite small (0.1 percent with a standard deviation of 3.5 percent) and is not statistically different from zero at conventional levels of significance.

2. Input Price Indices Are Highly Unstable

In contrast to the smooth behavior of published price series, such as the GDP-PI, input price series are highly erratic. For example, although Ad Hoc reports a simple average differential of 1.6 percent for California (based upon an average input price growth rate of 2.1 percent), the series actually grew by over 13 percent per year in its last two years, the very

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[49]Since national TFP growth is unavailable after 1990, we cannot calculate a national input price index for 1991 and 1992 and thus cannot measure the difference between the Christensen Associates' LEC input price changes and national input price changes for 1991 and 1992.

Figure 4
The Christensen Studies Show
Zero Input Price Growth Rate Differentials
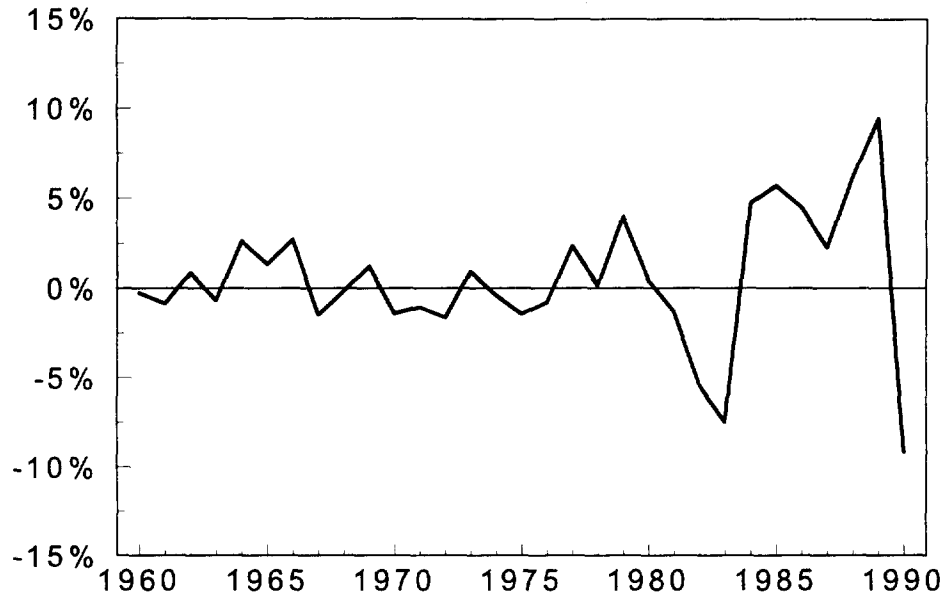
years that California's price caps were in place.[50] It is highly unlikely that California's LECs

experienced anything like this level of input price inflation in their dealings in the real world

during this time period. Such an index simply does not comport with reality and should be

given no weight in setting the productivity factor in any price cap plan.

In contrast, Ad Hoc would want the Commission to ignore the extreme fluctuation

in their series and blindly assume that the simple average is a reliable forecast of input price

growth over the next few years. Because they are recommending a change that amounts to a

200 basis point increase in X, it would appear that the Commission should be given some level

of confidence that what Ad Hoc has measured is truly different from the current program.

Such confidence cannot be given. We show in Table 2 above that Ad Hoc's input price series

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[50]See Table 1 above.

cannot be used to conclude that LEC input prices grow at a different rate than national input prices.

3. Input Price Indices from TFP Studies Differ from Ordinary Price Indices

Standard price indices are easily understood in concept. One merely samples the relevant goods, observes their prices, applies the appropriate weights and calculates the index. In particular, such indices are based on goods and prices that can be observed and measured. These quantities and prices, in turn, are based on actual market outcomes.

The input price indices--constructed as a by-product of TFP studies--are very different. In a TFP study, input prices are used only to calculate the relative weights of different inputs used in construction of the quantity index of aggregate input. These weights are expenditure weights, where expenditure is the product of price and quantity. While calculation of labor and materials prices and expenditures is straightforward, the estimation of capital expenditure and the price of capital is quite complex.[51] Moreover, for purposes of a TFP study, capital expenditures do not have to be measured with a significant level of precision: even though there are a number of ways to calculate such expenditures, the capital share of the input quantity index tends to be around 50 percent for LECs. And since it is the level that is important, fluctuations around 50 percent do not matter much in the estimate of the input quantity index.

In contrast, when the same formulas are used to calculate an input price index, the year to year change becomes very important. It is elementary that accurate calculation of changes is much more difficult than accurate calculation of levels.

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[51]The capital expenditures of a TFP study can be very different (numerically) from the capital components of a revenue requirement.

Additional insight into the problem can be gained from observing how capital prices are calculated. According to ETI, the capital price index *(c)* equals the price index of new equipment *(J)* multiplied by the sum of return on capital *(r)* plus depreciation *(d)* less the inflation rate for new equipment *(I)*:[52] i.e.,

$$c_t = J_t \ (r_t + d - I_t) \ .$$

This formula is the answer to the following question: how much does it cost to hold an investment in telephone plant for one year. The answer is the lost opportunity of tying up funds (rate of return), the loss in value of the asset (depreciation), offset by nominal changes in equipment price.

Examination of this equation reveals some problems in measuring the price of capital. First, none of the variables is readily observable. As this Commission is well aware, measuring rates of return on capital and economic depreciation is difficult and highly contentious. Developing price indices for telephone plant and equipment (TPIs) is not an easy task.

Second, the variables are not determined independently in the market; rather, they are inherently related. For example, both equipment inflation and return will change together with the underlying rate of inflation in the economy. Similarly, the price of new equipment and depreciation are intimately linked in that changes in the price of new equipment determines how much economic depreciation has occurred. While measuring these variables independently will have little effect on the relative size of capital expenditures--which is the only use that a TFP study makes of the price of capital--interactions among these variables can and do wreak havoc with estimates of year-to-year capital price changes.

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[52]ETI study, p. 63. ETI's formula inappropriately leaves out the effects of taxation on capital expenditures.

Table 3
Small Changes in Equipment Prices Cause
Large Changes in ETI's Capital Price Estimates

Year	Return	Depreciation	Equipment Price	Capital Price	Annual Change
1	10%	7%	1.00	0.170	
2	10%	7%	0.98	0.187	9.3%
3	10%	7%	1.01	0.142	-27.5%
4	10%	7%	0.99	0.188	28.4%
5	10%	7%	1.03	0.135	-33.2%
6	10%	7%	1.01	0.192	35.0%

Third, small changes in equipment prices produce large swings in capital prices, so extremely precise measurement of equipment prices would be required if the resulting capital price index were to be useful. Using ETI's capital price equation, Table 3 illustrates this phenomenon, assuming a return of 10 percent, depreciation of 7 percent, and equipment prices that fluctuate slightly around a normalized value of 1.0, a pattern exhibited by recent TPIs produced by some LECs. Despite the modest changes in equipment prices, the resulting annual capital price changes are in the double digit range, both positive and negative. In fact, annual changes in capital prices of this magnitude were present in ETI's California study, in which capital prices grew by about 25 percent in each of the last two years of the study.[53]

None of this discussion should be taken as a criticism of TFP studies--the capital price equation in a TFP study has a very limited purpose in its traditional use, and variations in the price of capital have only a small effect on the input quantity index used to calculate

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[53]Cross Examination of Dr. David J. Roddy, Application 92-05-002 and 92-05-004, before the California Public Utilities Commission, June 22, 1993, Tr. 1600.

TFP growth. Further, the solution to these difficulties is not to calculate capital prices with greater care--information and theoretical problems appear to be much too difficult. Rather, the correct answer is to recognize that historical input price growth differences cannot be calculated sufficiently accurately to support forecasts of future input price growth differences.

D. The Consumer Productivity Dividend

Ad Hoc recommends that its proposed X factor exceed its estimated historical level by a stretch of 1 percentage point. Such a stretch is an inappropriate increase in the initial benefits that flow to consumers and has no precedent for an industry-wide price cap plan.

The FCC's rationale for a consumer productivity dividend (CPD) was that by presenting the LECs with some of the incentives faced by unregulated firms in competitive markets, the adoption of incentive regulation would--in principle--increase the rate of productivity growth for regulated firms. Even though this additional productivity growth would not be forthcoming under continued rate of return regulation, the Commission reasoned that consumers should obtain a share of the benefits from the change in the regulatory paradigm, and in that spirit, they raised the productivity offset 0.5 percentage points above their estimate of the historical level of X.[54]

By this reasoning, it makes no sense to add a further CPD to the CPD already present in the price cap formula and accumulated over four years in the current level of PCIs. Absent a fundamental change in the price cap plan that would specifically yield additional productivity growth that could be shared with customers, there is nothing additional to be shared

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[54]Price Cap Order , ¶ 76.

in this review. The mere fact that the price cap plan is being reviewed does not warrant further arbitrary increases in the productivity offset above its historical level.

E. Earnings-Based Measures of Productivity Growth

Several parties assert that LEC earnings have risen under the price cap plan or are simply too high, and they propose an increase in X to resolve these problems. Both AT&T and GSA base their productivity offset recommendations on a direct assessment of the LECs' actual earnings performance during the price cap period. While employing somewhat different methodologies, both answer the question: what would the X factor have to have been for the LECs to earn the target return (11.25 percent) during the price cap period. Both then propose a mid-course adjustment to the Commission's productivity offset based on that calculated historical X.

1. Interpretation and Use of Actual Productivity

Because the very design of incentive regulation requires that the LECs not be required to forfeit the gains obtained from their own superior performance, measurements of achieved productivity must have only a limited role: to serve as a diagnostic measure of whether the original parameters of the plan were seriously in error. There are two reasons for this: (i) productivity growth exhibits fairly large year-to-year variations, so that most observed deviations from the expected value are well within the normal range and (ii) unusually large productivity gains could be the result of management effort, and adjusting the plan subsequent to this effort would severely erode the incentives of the plan to the point of creating a thinly-disguised version of traditional cost-plus regulation.

On p. 10, ETI asserts that

"...in competitive industries the price adjustment mechanism is subject to *constant review* by the marketplace itself; price levels are affected by a variety of processes that work to limit the actions of individual producers and the duration of gains that may result from actions that an individual firm may be able to initiate. While LECs may complain that periodic "reviews" of price cap regulation, such as the instant proceeding, amount to reinstatement of RORR in disguise, this conveniently overlook (sic) the inherently transitory nature of gains achievable in competitive markets."

There are several problems with this view. First, technological or process innovation requires a long period of time to diffuse throughout a company or a network, so that even in competitive markets, the duration of gains or losses from productivity growth can be quite long. Second, while competitive advantage in rivalrous markets is transitory, there is no automatic link between higher productivity growth of one firm and higher productivity growth of the industry average. If a firm can beat the industry average TFP growth every year, it will experience above-normal earnings every year, and--most important--a rise in its measured regulatory accounting earnings will not trigger any force that will lower its earnings in the future. In competitive markets, there is no incentive to withhold productivity gains from the market for fear that they will engender a productivity penalty in the future. Price cap reviews that measure achieved productivity gains and raise or lower the productivity target accordingly thus do not emulate any feature of a competitive market.

2. Measurement of Productivity Performance through Earnings Performance

There is a factual problem with using LEC earnings under price caps to infer that the initial productivity offset was too small. The price cap plan contemplated a wide range of acceptable earnings outcomes: a floor was established at 10.25 percent, 50/50 sharing of earnings would begin at 12.25 percent, and earnings were capped at 16.25 percent. Earnings within this range would be permitted to deviate (up or down) from 11.25 percent, and that deviation was not unintentional. Indeed, it constitutes the essential difference between the price cap plan and

ordinary rate of return regulation. If the range of acceptable earnings outcomes were smaller--
e.g., if it shrunk to zero (around 11.25 percent)--the price cap plan would operate exactly as
theoretical rate of return regulation. The price cap formula would adjust prices every year, but
earnings adjustments would ensure that prices in total would change just as they would have
changed had rate of return regulation continued. Thus earnings that deviated from 11.25 percent
but remained in the range contemplated by the plan would not be considered excessive or
deficient, and allowing earnings to deviate from 11.25 percent is an essential component of the
plan.

According to AT&T's data, no RBOC rate of return fell outside this range, averaged
over the price cap period, and the average rate of return for the price cap companies fell
comfortably in the center of the range. Adjusting the plan on the basis of actual outcomes that
are clearly within the range contemplated by the plan would simply be a return to the bad old
days of traditional cost-based regulation, which the Commission rightly rejected as antiquated
and in need of change.

Second, LEC earnings--as measured by regulatory accounting rules--are notoriously
poor proxies for economic profit. Moreover, changes in accounting earnings are also a poor
measure of changes in economic profit. In particular, the accounting treatment of depreciation
for regulated LECs is based on asset lives that are currently too long and have historically been
too long, so that LEC accounting profits are overstated relative to economic profits. As
telecommunications markets become more competitive, market forces will undertake a more
realistic appraisal of the LEC capital stock, and as asset lives are reduced, the associated
changes in accounting profits will be again a poor measure of changes in economic profits.[55]
In addition, regulated earnings are affected by numerous accounting conventions, so that a firm's

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[55]See, for example, Riva Atlas, "Honesty isn't such a bad policy," Forbes, July 4, 1994, p. 118.

decision to accelerate the depreciation expense associated with an asset would affect measured productivity growth in this method but would not, in reality, affect the growth rates of outputs or inputs.[56]

A second problem with inferring a productivity differential from earnings data is that the calculation presupposes that all other aspects of the plan are performed correctly. In particular, if some exogenous cost changes--positive or negative--were not accounted for under the price cap plan or if their effect on costs beyond their effect on the GNP-PI were calculated incorrectly, one could no longer infer the level of the achieved historical productivity offset from data on earnings.

While the analyses presented by AT&T and GSA are subject to the above caveats, there is an additional problem in AT&T's arithmetic. The average rate of return reflects the cumulative impact of productivity gains over several years, not just one year's effect. Therefore, AT&T's estimate in Appendix C is too high. To correct the estimate, we first observe that when the accounting rate of return increases linearly between the starting value and the end-of-period value, the average over a three-year period occurs in the second year. Thus, the average return represents the cumulative impact of two years worth of productivity gains, not the single year gain implied by AT&T's analysis, so that AT&T's estimate of X is significantly overstated.

AT&T did not provide sufficient documentation to evaluate the estimates presented in Appendix B. We note that if they made the same error in not accounting for the cumulative nature of productivity gains, the estimated value from Appendix B is significantly overstated as

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[56]A TFP study--like the Christensen Associates study filed in this Docket--that uses economic depreciation in its calculation of the capital stock is not affected by these accounting conventions that distort the analyses presented by AT&T and GSA.

well. That is, the reported differential of 2.67 between AT&T's recommended productivity offset and X (5.97 - 3.3) would fall to 1.33.

F.   Summary: Superior LEC Performance Must Not Be Penalized by Inappropriate Changes to the Price Cap Parameters

Because price cap regulation decouples prices from accounting costs, regulated firms operate under efficiency incentives similar to those facing unregulated firms. However, the efficiency benefits from price caps depend on managers having confidence that superior cost savings will not ultimately be taken away through inappropriate adjustments to the plan. For example, if management believed that superior realized productivity would trigger an increase in the productivity target in the future, the efficiency incentives would be severely eroded.

While the actual performance (including productivity levels) of the LECs during the price cap period may be germane to the review of the program, the results must be interpreted in the context of the Commission's intent in establishing the plan. In order to ensure long-term stability and to avoid a return to traditional regulation, it is absolutely essential that productivity levels realized under price caps not be used to recalculate the price caps productivity target. For example, suppose the LEC implemented a cost-savings program that lowered the level of costs by one percent, but did not affect the rate of change in costs in the future. Such a change would show up as a one percent improvement in productivity in the year it occurred. If this measurement caused the productivity target to increase by one percent, the LEC would be forced to give back its increased earnings and would be committing to make similar cost savings in every future year. Returning earnings from cost reductions would be exactly what occurs under traditional regulation with regulatory lag, and would constitute a failure to reward efficiency improvements that the Commission sought to encourage with price caps. Moreover, it would

be wholly incorrect to incorporate a one-time cost reduction into a long-term productivity offset by effectively assuming that the cost reduction would continue to take place in every year.

Rather, actual performance levels should be compared to the range of outcomes consistent with the operation of the plan, as shown above. Only if levels fall above the range or some external change had occurred, e.g., greater emphasis on a particular goal of the Commission, would there be a reason to increase the original 3.3 percent productivity target. In this regard, we find AT&T's recommendation to increase the productivity target to absorb the full amount of the LECs' achieved productivity offset (less a 0.5 percent offset) especially puzzling and troublesome. First, as a price-cap regulated company itself, AT&T should know how debilitating it would be to management's incentives to innovate if it were required to give up all productivity gains (or were permitted to make up for inadequate productivity growth) after each price cap review. Second, AT&T's calculation is based solely on the LECs rate-of-return. We note that the LECs' average rate of return of 12.34 percent[57] is somewhat less than AT&T's average under its price cap plan of 12.73 percent (as reported by the FCC).[58] Yet, AT&T passed its initial price cap review without any suggestion that its performance should be the basis for lowering its prices.

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[57]Calculated as the average of 1991-93 annual earnings of price cap LECs as shown in Table 5, p. 28 of the Comments of Southwestern Bell Telephone Company.

[58]AT&T's interstate rate of return for 1993 was 13.49 percent. Moreover, AT&T's composite depreciation rates are much higher than those of the LECs (10 percent compared with 7 percent). If the LECs recalculated their earnings using AT&T's depreciation rates, LEC earnings would be significantly lower than AT&T's.

II. No True-Up of Prices is Appropriate to Reflect Lower Interest Rates

AT&T, Ad-Hoc and MCI advocate a one-time adjustment to the price cap PCIs in order to adjust prices to reflect a reduction in interest rates and the LECs' cost of capital since 1989. There are two major problems with these proposals. First, there is no evidence that the cost of capital for price cap LECs has fallen or will be lower over the next three years of the plan than at present.[59] Second, the proposal to reset rates to account for changes in interest rates betrays a basic misunderstanding of the price cap plan actually adopted by the Commission in CC Docket No. 87-313. In that plan, changes in interest rates--and concomitant changes in the prices of capital and other factors of production--were not treated as exogenous cost changes, nor were they made part of the annual update to account for inflation and productivity growth. The proposals to reset LEC PCIs to account for changes in the cost of capital are merely vestiges of rate of return regulation which have no role in the price cap plan adopted by the Commission. In addition, even if contemporaneous changes in factor prices had been part of the Commission's plan, the proposed adjustments to the PCIs ignore (i) factor price changes other than capital, (ii) double-counting for factor price changes reflected in changes in the GNP-PI, and (iii) the historical level of differential factor price changes reflected in the X-factor estimated by the Commission from long-term and short-term real telecommunications price changes.

A. The Cost of Capital Has Not Fallen

Citing various pieces of evidence, intervenors assert that the cost of capital for the price cap LECs has fallen from the 11.25 percent to which rates were set in 1990 and that the

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[59]See section IV of "Price Cap Performance Review for Local Exchange Carriers" a report by Dr. Randall S. Billingsley on behalf of the USTA filed as Reply Comments in CC Docket No. 94-1.

Commission should implement a one-time reduction in the LEC PCIs or increase the productivity offset to account for the reduction in the cost of capital. No credible evidence is presented to show that the cost of capital for any price cap LEC has changed. Rather, intervenors have examined broad changes in financial markets and inferred the effect of those changes on the cost of capital of a generic firm. Factors other than changes in interest rates that affect the cost of capital for an individual firm are ignored. What is clear from the financial record is that interest rates fell after 1989, reached a floor in 1993, and have been increasing sharply for the past six months. Figure 5 shows recent 30 year Treasury bond rates along with the implementation and review dates for the AT&T and LEC price cap plans. As should be clear from Figure 5, long term interest rates fell further between the AT&T price cap plan's implementation and review dates than between the corresponding dates for the LEC price cap plan. Neither AT&T nor the other interexchange carriers petitioned to reduce AT&T's PCIs to account for the reduction in interest rates, and the Commission correctly made no such adjustment. There is even less evidence to support resetting LEC PCIs because of changes in the cost of capital than there was to support resetting AT&T's PCIs.

More important, in a price cap plan, the level of the price of capital is irrelevant for determining the annual change in the PCI. Rather, since the price cap plan updates the PCIs annually to reflect inflation and the productivity offset, what matters is the change in the price of capital, for it would be the change in a factor price that would affect the change in the PCI.[60] Thus if the price of capital to the LEC is falling--and if, as AT&T claims, the LECs are more capital-intensive than an average firm--the LEC will derive a greater benefit from the price reduction than the annual change in the GNP-PI reflects. If factor prices are,

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[60]As discussed below, factor price changes were not treated as exogenous changes in the price cap plan actually adopted by the Commission.

Figure 5
Interest Rates Fell Further Under the AT&T Price Cap Plan
Than Under the LEC Price Cap Plan
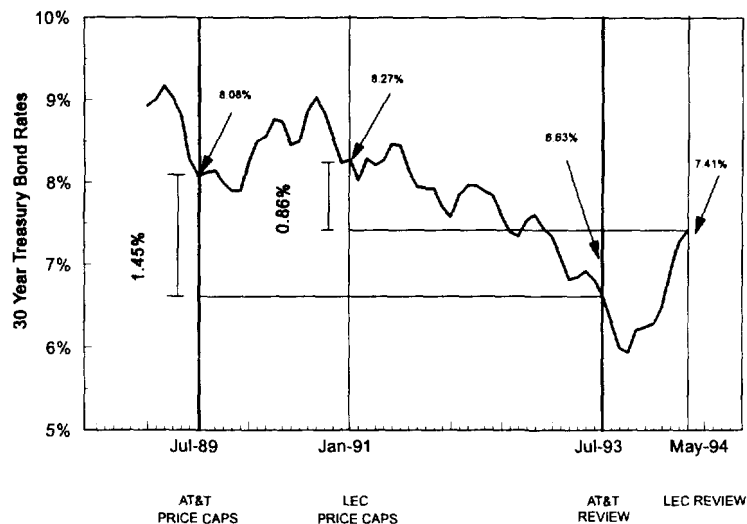
on average, falling faster for the LECs than for average firms, the LEC will find it easier to achieve its productivity offset. However, the opposite is equally true: to the extent that falling interest rates cause the LECs to experience greater relative reductions in factor prices, increases in interest rates cause the same LECs to face greater relative increases in factor prices. To the extent they are relatively capital intensive, LECs benefitted under price caps from falling interest rates; in the same way, they are currently--and likely will continue to be--penalized when interest rates rise.

B. PCIs Should Not Be Reset to Account for Interest Rate Changes

Even if interest rates and the LECs' cost of capital had unambiguously fallen, the price cap plan as adopted by the Commission did not contemplate changes in the PCI tied to changes in factor prices. If it did, the mechanism by which changes in factor prices affect the PCI in a price cap plan would be very different from the simple resetting of rates recommended

by AT&T, Ad Hoc and MCI in this case. In particular, it is absolutely false to claim, as does GSA, that current LEC prices are set to earn 11.25 percent; as is clear from the mechanics of the price cap formula, LEC prices have been adjusted every year by GNP-PI less the productivity offset,[61] so that the rate of return embedded in current LEC prices depends on the difference between LEC and US total factor productivity growth and the difference between LEC and U.S. input price growth.[62] Thus GSA is incorrect when it claims that

> Conceptually, if a LEC's productivity has increased at the same rate as its chosen price cap productivity factor (either 3.3 percent or 4.3 percent), its earnings would be 11.25 percent in 1993, since this is the earnings level at which rates were set on January 1, 1991. (p. 8)

Conceptually, if the LEC just achieves its historical TFP differential and the factor price differential approximates its historical level[63], then the firm will continue to earn its cost of capital, whether or not that cost increases or decreases over time.[64]

To understand why the proposed adjustments to the LEC PCIs are arithmetically incorrect under the price cap plan, we must determine how changes in factor prices--of which the price of capital is one--are accounted for in the Commission's price cap plan.

1. Factor Price Changes Are Not Exogenous Cost Changes

In establishing its price cap plan, the Commission considered accounting explicitly for the input price changes of the regulated firm and rejected that approach to the annual price

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[61] and exogenous cost changes which, in net, have resulted in further rate reductions.

[62] Recall that the productivity offset X can be expressed as the difference in LEC and U.S. TFP growth offset by the difference (if any) between LEC and U.S. input price growths: $X = (dTFP - dTFP^N) - (dw - dw^N)$.

[63] Or if the regulated firm attains its target X irrespective of differences in the productivity and factor price components of that target.

[64] To see this, recall that the price cap annual adjustment formula is derived by differentiating the identity that total revenue equals total cost for the regulated firm. When the price cap adjustment formula is applied to the firm's prices and it just attains its assigned X, the identity continues to hold, so that total revenue continues to equal total cost, irrespective of how costs may have changed due to changes in factor prices.

cap adjustment.[65] The Commission could easily have used the simple, firm-specific price adjustment formula:

$$dp_t = dw_t - dTFP$$

or it could have updated the differential price adjustment formula each year for changes in national inflation (GNP-PI) and the differences in input price growth rates between the firm and the U.S.:

$$dp_t = dGNP\text{-}PI_t - [\ dTFP - dTFP^N] + [\ dw_t - dw_t^N]$$

where the t subscripts denote quantities that are updated each year while the absence of t subscripts on TFP growth and the TFP growth differential indicates that TFP growth and differential TFP growth are treated as targets and are held constant over time in the plan. However, the Commission did not adopt either of these approaches because (i) input prices are partly under the control of the firm and (ii) input price indices are difficult to calculate and are not calculated or maintained by an independent, reliable entity. In the former case, the incentives of the price cap plan to reduce costs would be diminished if the LECs could pass through changes in wage rates, for example, automatically to their customers. In the latter case, simplicity and verifiability require calculation of the inflation factor by someone other than an interested party.[66] For these reasons, the Commission's price cap plan does not contemplate changing the PCI to account for changes in input prices but rather builds the historical relationship between LEC and national input prices into the fixed productivity offset X.[67]

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[65]Price Cap Order, ¶ 54.

[66] and that the calculation not depend critically upon data that can only be provided by the LEC.

[67]Factor price changes are not listed in the extensive list of exogenous events detailed in the Price Cap Order, ¶s 166-190.

2. The Historical Factor Price Differential is Part of the Target X

Recall the mechanism by which the Commission determined that a productivity offset X of 3.3 percent per year was a reasonable target. It examined the long term relationship between national inflation and telecommunications prices (the Spavins-Lande study) and the short term relationship between national inflation and LEC carrier access charges (the Frentrup-Uretsky study). The final X selected was the numerical average of these price studies, augmented by a consumer productivity dividend of 0.5 percent reflecting the expectation that the adoption of price cap regulation would lead to higher productivity growth which should be shared between the LECs and their customers.[68] The X that was measured is thus equal to the historical level of

$$X = (dTFP - dTFP^N) - (dw - dw^N);$$

it does <u>not</u> embody any assumption about the differential rate of growth of input prices. Rather, it simply estimates the difference between the productivity differential and the input price differential, whatever those components may happen to have been. If LEC input prices have always grown more slowly than U.S. input prices, that difference is fully accounted for in the historical studies used by the Commission to measure X. Any attempt to correct the current PCIs for alleged changes in LEC input prices must account for the <u>historical</u> input price differential that is embodied in the Commission's measure of X or else differences between LEC and U.S. input price growth rates would be double-counted. Alternatively phrased, if the Commission intended its price cap plan to adjust LEC PCIs to account for difference in LEC and U.S. input price growth rates, it would have used a different X than the one it selected:

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[68]<u>Price Cap Order</u>, ¶ 76.

it would have removed the historical difference in LEC and U.S. input price growths from the

historical difference between U.S. and telephone output price changes.

3. If Factor Prices Changes Were Part of the Plan, PCI Would not be Updated for Interest Rate Changes

If the Commission had adopted a price cap plan that would have raised or lowered

PCIs whenever interest rates rose or fell, it would not have adjusted the PCIs in the manner

suggested by AT&T, Ad Hoc and other intervenors. In particular, in order to maintain the

theoretical justification for the price cap annual price adjustment formula, the adjustments would

have to change in three important respects:

(1)   The adjustment would have to account for changes in <u>all</u> factor prices, not just

interest rates or the price of capital. If the annual adjustment formula treated price changes

for some inputs differently than for others, it would create a distortion in the regulated LEC's

choice of inputs and would undermine the improvements in incentives that price cap regulation

was intended to bring.[69] In any case, it certainly makes no sense to adjust PCIs to account

for inputs whose prices have increased while ignoring prices of inputs that have decreased.

(2)   The adjustment would have to account for <u>differences</u> in input price growth rates for

the LEC and for the U.S. as a whole. Simply adjusting the PCIs to account for changes in

the LEC's cost of capital ignores the fact that interest rates grew for all firms in the economy,

and the average effect of that change in input prices was reflected in the national output price

inflation rate, i.e., the GNP-PI. In its decision authorizing a price cap plan for Pacific Bell

and GTE-California, the California Commission recognized that input price changes--and changes

in the price of capital in particular--are already reflected in the measure of national inflation:

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[69]For example, labor prices have increased since the implementation of LEC price caps; adjusting the PCIs for decreases in the price of capital but not increases in the price of labor would lead the LEC to use more capital and less labor than an unregulated cost-minimizing firm would use.

We note that if there were significant differences expected in costs due to changes in interest rates they would be captured, albeit with a short lag, in the price cap mechanism.[70]

(3)   Finally, the adjustment would have to account for <u>differences</u> (from the historical average) in the input price growth rate differentials. If LEC input prices always grew more slowly than U.S. input prices, that fact would be accounted for in the Commission's estimates of X, and only the difference between the realized input price growth differential and the historical differential would be used to adjust the PCIs. To use the entire input price growth rate differential would be to double-count the historical input price differential already present in the Commission's estimates of X.

In summary, if an adjustment to the LECs' PCIs were to be made to account somehow for an alleged change in interest rates, the Commission would have to recognize how its plan has <u>already</u> accounted--in part--for changes in LEC and U.S. input prices. Adjusting PCIs for interest rate changes as if three years of price cap regulation had never occurred would be simply, arithmetically, incorrect.

Of course, this discussion of how a flow-through of input price changes should occur under price cap regulation is somewhat academic. All of the evidence shows that there are no long term differences in the rates of growth of LEC and U.S. input prices, and, in the future, the likely continued increase in interest rates would precisely reverse the relative growth of LEC and U.S. input prices. And, finally, it must be recognized that the Commission did not, in fact, adopt a plan that contemplated or permitted a flow-through of changes in input prices to the regulated LECs' PCIs.

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[70]<u>Re Alternative Regulatory Frameworks for Local Exchange Carriers</u>, Decision 89-10-031, 33 Cal.P.U.C.2d 43 (1989).

III. Other Issues: Incentive Regulation and Infrastructure Investment

On page 2, footnote 14, MCI claims that adoption of incentive regulation "has not guaranteed that LECs will make infrastructure investments," citing as support a NERA study "Telephone Company Performance Under Alternative Forms of Regulation" that MCI claims to show

> no significant effect of incentive regulation by the states on investment in four infrastructure enhancements: digital switching, fiber, ISDN, nd SS7. In addition, they noted no significant positive effect on investment in these areas for those states whose incentive regulation plans included price indexes of sharing mechanisms.

MCI has misinterpreted the results from the cited study. The study noted that too little time has passed to expect to observe statistically significant changes in telephone company behavior stemming from the adoption of incentive regulation. The measurement difficulty is particularly acute when the effects of specific types of incentive regulation (e.g., "price indexes of (sic) sharing mechanisms") are examined because (i) there are few examples of each specific type in place in the United States, (ii) the specific type of regulation never appears in isolation but rather as an amalgam of other types of incentive regulation, and (iii) rate of return regulation, as practiced, frequently contains elements of incentive regulation plans. Nonetheless, the cited study showed that the adoption of a regulatory reform plan accelerated the diffusion of digital switching technology in the network and had no statistically significant effect on the diffusion of optical fiber and SS7 and ISDN platforms. As expected, the study showed no relationship between the volume of investment and the adoption of incentive regulation; the result is sensible because under most incentive regulation plans the risk of capital recovery for new investment shifts to the regulated firm, so that it faces the same incentives as unregulated firms to invest

the proper amounts in the appropriate technologies. Whether such incentives reduce or increase the volume of investment depends on whether current investment under rate of return regulation is higher or lower than its economically efficient level. Finally, we note that the cited study does show other positive effects stemming from the adoption of an incentive regulation plan: higher TFP growth, lower growth in toll prices, higher residential telephone penetration, and more rapid improvement in service quality.

IV. Conclusions

At this first review of the LEC price cap plan, it is important that the Commission recall the purpose of the review in the economic structure of the plan. If the plan is to succeed in the long run, the price-cap LECs must become more market-driven companies, expanding demand for their networks by introducing new products and services, discovering new markets, and serving their current customers well. The plan set in place in January 1991 provides that if--and to the extent that--the regulated firm undertakes and succeeds in this endeavor, it will be rewarded and to the extent that it fails, it will be penalized. To motivate corporations and individuals to make significant changes in response to changed incentives, it is absolutely essential that all parties believe the incentives have changed from traditional regulation, the change is permanent, and the incentives are real.

In the theory of price cap regulation, the mid-course review is _not_ a time to true-up details in the formulas or to fine-tune aspects of the plan to better align the regulated firm's prices with its costs. The regulated firm must be given time to benefit from its successes and to suffer from its failures. If the plan is tweaked every four years so that the regulated firm has a reasonable chance to earn no more or less than its current cost of capital, we will have

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simply replaced ordinary rate of return regulation with rate of return regulation having a mandated four year lag. Such a scheme would not generate the incentives required to change radically the regulated firm's way of doing business.

The purpose of the review is to ensure that there are no gross errors in the components of the formula and that unanticipated changes in circumstances have not made it necessary to change some aspect of the plan. Competitors and customers have asserted that LEC PCIs should be reduced and/or LEC productivity offsets should be increased because (i) LEC earnings have exceeded their authorized cost of capital and (ii) the cost of capital has fallen since the implementation of the plan. On the contrary, we have shown that

- the productivity evidence indicates that if any change in X is warranted, it would be a reduction. The Christensen Associates' direct measure of LEC TFP growth implies an historical X of about 1.7 percent, and if the Commission updated its previous price-based estimate of the productivity offset, it would obtain an X of about 2.4 percent.

- the Christensen Associates study provides additional evidence that, in the long run, LEC and U.S. input price growth rates are the same and that, since divestiture, the measured differences in growth rates are not statistically significant. Hence, there is no reliable basis on which to adjust the measured differential in LEC and U.S. TFP growths to calculate an X for future use.

- the decline in interest rates during the LEC price cap plan is smaller than the drop in interest rates during the initial AT&T price cap plan. Thus, there is less reason to adjust LEC rates for changes in the cost of capital than there was to adjust AT&T rates.

- the LEC price cap plan does not treat changes in the cost of capital--or any other input--as an exogenous cost change to be passed through to customers. Moreover, the plan should not pass through such cost changes because to do so would be to eliminate the LECs' incentives to reduce the prices that they pay for the factors of production they purchase.